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A STUDY OF THE DEGRADATION OF MEVINPHOS (PHOSDRIN) WHEN APPLIED TO HEAD LETTUCE IN IMPERIAL COUNTY, CALIFORNIA JANUARY-FEBRUARY 1976

By

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INTRODUCTION

Mevinphos is an extremely toxic organophosphate. It has an acute oral LD_{50} (rat) of approximately 3.7-12.0 mg/kg and an acute dermal LD_{50} (rabbit) of about 16.0-33.8 mg/kg. It is readily absorbed through the skin. Toxic effects are related to blood and tissue cholinesterase inhibition. It is one of the most toxic pesticides currently used.

Mevinphos is used to control aphids, mites, leafhoppers and many other insects on a wide variety of field, forage, vegetable and fruit crops, including lettuce. During the year 1975, over 85,429 pounds of mevinphos was reported as applied to nearly 200,000 acres of head lettuce fields in California.

Mevinphos is usually sold under the name of Phosdrin and as such when sold consists of two isomers; 60% alpha-Phosdrin and 40% related compounds, including beta-Phosdrin. The pesticide is marketed as an emulsifiable concentrate, a water-soluble solution and a dust. Label directions for the formulation used for this study, Red Top Phosdrin 4 Spray (a water-soluble solution) recommend using no more than one pint per acre, with a 4-day preharvest interval. The label states that workers should not be allowed to enter treated fields on the day of treatment. Tolerance for Phosdrin on head lettuce has been set at 0.5 ppm.

APPLICATION

A 70-acre field of head lettuce was treated in the following manner:

Red Top Phosdrin 4 Spray - 1.94 pts. (.49 lbs. actual)
Cygon 267 - .68 pts. (.227 lbs. dimethoate)
Dipel
Nutra-aid
Dilution rate - 10 gal./acre

These materials were applied by air on a calm day. A separate report was prepared covering the decay of Cygon in this lettuce field.

SAMPLING

Triplicate samples were collected at 1/2 hour, 1, 2, 3, 4 and 5 days after application. Samples each consisted of approximately 100 leaf

punches, 2.5 cm in diameter. The punches were taken from the wrapper leaves of different heads of lettuce. Samples are analyzed for surface and penetrated residue, while the third is used for total residue analysis.

Soil was sampled by collection of 50 small plastic spoonfuls of surface dust collected each time about one foot from the base of lettuce plants at 50 locales scattered across the field so that the final sample of soil for a field weighed about 100 grams.

Analytical Methods (Extraction from leaves)

The procedure used for the extraction of dislodgeable, penetrated, and total residues from leaf punches was originally published by Gunther in "The Bulletin of Environmental Contamination and Toxicology," 9, 243-249, 1973. It has been documented several times in detail, with modifications that were made to accomodate the various pesticides and their metabolites, that Worker Safety has been concerned with.

The sample container and leaf punches are weighed and the gross weight recorded.

Total Residues

1. The leaf punches are transferred to a blending jar. The empty sample container is again weighed and the net weight of the punches recorded.

2. Approximately 50 gms of sodium sulfate and 100 mls of ethyl acetate are added.

3. The sample is blended at high speed for 3 minutes, keeping the blender cup cool by immersing it in a container of cool water. The blender cup is removed and the sample allowed to settle.

4. An aliquot is decanted into a teflon-capped bottle and stored in the freezer prior to cleanup and analysis.

Dislodgeable Residues

1. Fifty mls of water and approximately 4 drops of Sur-Ten solution (1:50) is added to the sample containers. The containers are capped and placed in a multi-purpose rotator and rotated at 30 cycles/min. for 60 min. The aqueous solution is decanted through a glass wool plug into a 500 ml separatory funnel.

2. The punches are rotated a second time, using 50 mls of water and 4 drops of Sur-Ten solution, for 30 min. This is added to the first extraction.

3. The sample is then hand-shaken for approximately 10 secs with 30 mls of water. The container is drained into the separatory funnel with the first two extractions.

4. The aqueous solution is extracted three times with 50 ml $CHCl_3$. The solvent is filtered through sodium sulfate into a glass stoppered mixing cylinder and the volume is recorded. The solvent is mixed in the cylinder. An aliquot is decanted into a teflon-capped bottle and stored in the freezer prior to cleanup and analysis.

Penetrated Residue

1. After the last water rinse is drained for the dislodgeable residue, the punches are transferred to a blender jar. The empty sample container is weighed and the net weight of the punches recorded.

2. Approximately 50 gms of sodium sulfate and 100 mls of ethyl acetate are added.

3. The sample is blended and handled the same as the total residue sample.

Analytical Methods (Extraction from Soil)

1. Finely divide soil sample to remove or break up lumps.

2. Air dry sample if muddy.

3. Add 10% water by weight; mix well.

4. Extract with a 2:1:1 petroleum ether/ethyl ether/acetone mixture. Use maximum amount compatible with sample container. (There must be free liquid over soil.)

5. Place on jar rotator or shaker for 1 hour.

6. Filter an aliquot for instrument analysis; concentrate if needed.

Analytical Methods (Chromatography)

Detector: Varian 2700, FPD detector in its phosphorus specific mode.
Column: 3% OV-275, 100/120 Chrom W(HP), 6' x ¼ x 2mm ID
Column temp.: 175° C
Injector temp.: 230° C
Detector temp.: 2-230° C
Retention times: alpha-Phosdrin - 2.0 min.
beta-Phosdrin - 2.8 min.

RESULTS

Weather conditions for the study period are recorded on Table 1. The average maximum and minimum temperatures were 80.7° and 39.2° F., respectively.

The results of the study are recorded in Tables 2 and 3 and Figures 1 and 2. Phosdrin decays rather quickly. In four days, the total Phosdrin residue had fallen below 0.01 ppm. Twenty-four hours after application, the surface Phosdrin residue on the wrapper leaves was as low as 1.0 ppm. The study of Phosdrin residue in soil should be done again as the results show some inconsistency.

TABLE 1: Daily Temperature and Precipitation

Weather observations were taken at El Centro, Imperial County, California

Date (1976)		Temperature (°F.) Maximum	Minimum	Precipitation (Inches)
January	29	79	36	
	30	80	37	
	31	82	40	
February	1	80	40	
	2	82	39	
	3	81	43	
	Average	80.7	39.2	Total 0.00

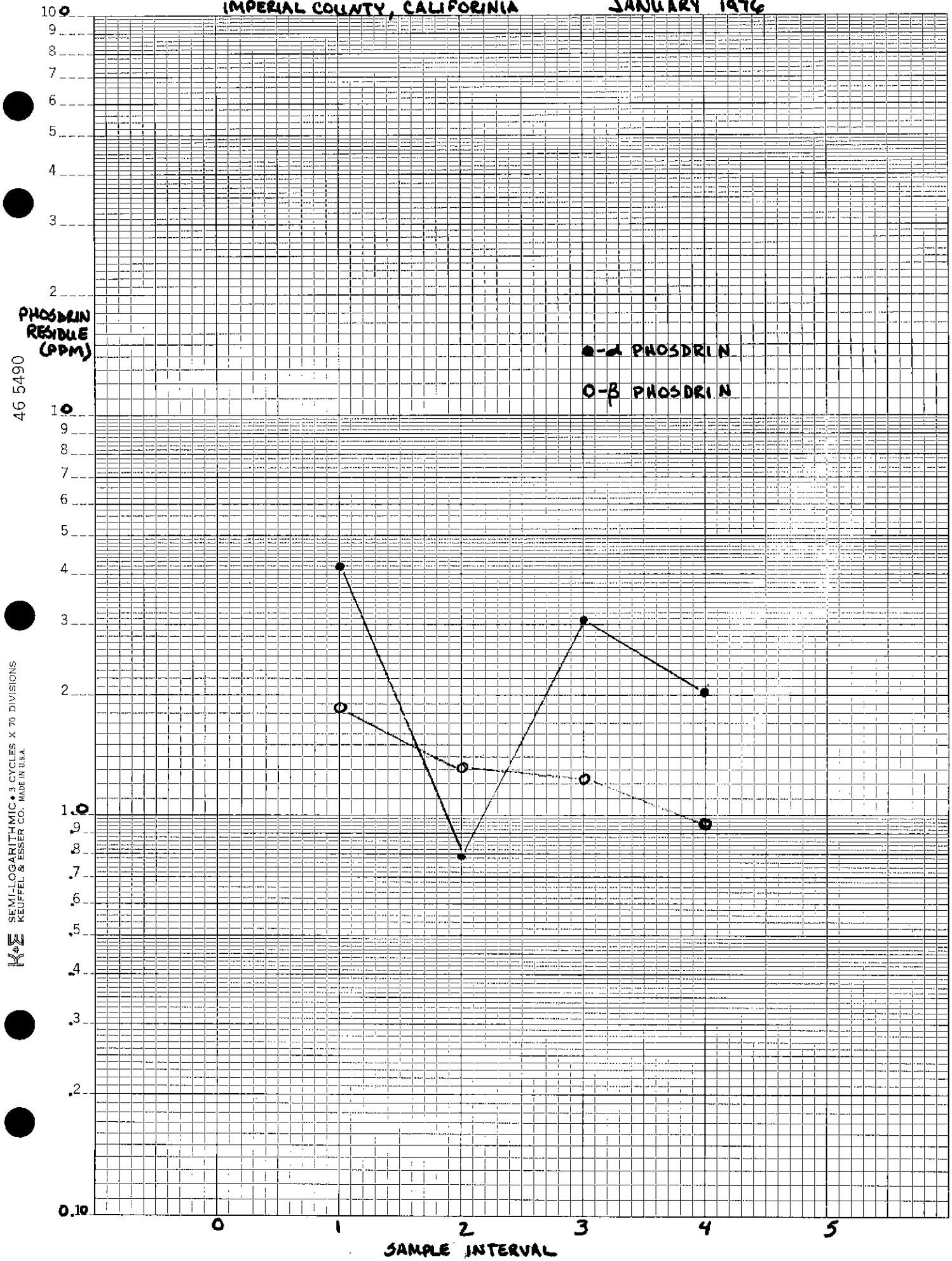
TABLE 2: Phosdrin Residue on Head Lettuce in Imperial County, California

Date (1976)	Sample Interval	Sample Number	Surface Residue (ppm) alpha	Surface Residue (ppm) beta	Penetrated Residue (ppm) alpha	Penetrated Residue (ppm) beta	Total Residue (ppm) alpha	Total Residue (ppm) beta
1-20	1/2 hr.	1	8.67	4.52	16.7	10.2		
1-29	1/2 hr.	2	11.2	6.41	16.0	9.75		
1-29	1/2 hr.	3					25.1	16.2
1-30	24 hrs.	4	0.72	1.17	1.44	2.82		
1-30	24 hrs.	5	0.81	1.06	1.47	2.49		
1-30	24 hrs.	6					2.06	3.27
1-31	2 days	7	0.14	0.17	0.21	0.62		
1-31	2 days	8	0.10	0.14	0.37	1.17		
1-31	2 days	9					0.24	0.66
2-1	3 days	10	0.03	0.06	0.06	0.34		
2-1	3 days	11	0.02	0.05	0.05	0.20		
2-1	3 days	12					0.20	1.90
2-2	4 days	13	0.7	<0.05	0.03	<0.05		
2-2	4 days	14	0.1	<0.05	<0.01	<0.05		
2-2	4 days	15					<0.01	<0.05
2-3	5 days	16	<0.01	<0.05	<0.01	<0.05		
2-3	5 days	17	<0.01	<0.05	<0.01	<0.05		
2-3	5 days	18					<0.01	0.06

TABLE 3: Phosdrin Residues in Soil From Head Lettuce Field

Date (1976)	Sample Interval	Total Residue (ppm)	
		alpha-Phosdrin	beta-Phosdrin
1-29	1/2 hr.	No data	No data
1-30	24 hrs.	4.18	1.88
1-31	2 days	0.79	1.32
2-1	3 days	3.07	1.23
2-2	4 days	2.05	0.96

FIGURE 2: PHOSDRIN RESIDUE IN SOIL FROM A LETTUCE FIELD
IMPERIAL COUNTY, CALIFORNIA JANUARY 1976



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